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# Is the intention–behaviour gap greater amongst the more deprived? A meta-analysis of five studies on physical activity, diet, and medication adherence in smoking cessation

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**Objectives.** Unhealthy behaviour is more common amongst the deprived, thereby contributing to health inequalities. The evidence that the gap between intention and behaviour is greater amongst the more deprived is limited and inconsistent. We tested this hypothesis using objective and self-report measures of three behaviours, both individual- and area-level indices of socio-economic status, and pooling data from five studies.

**Design.** Secondary data analysis.

**Methods.** Multiple linear regressions and meta-analyses of data on physical activity, diet, and medication adherence in smoking cessation from 2,511 participants.

**Results.** Across five studies, we found no evidence for an interaction between deprivation and intention in predicting objective or self-report measures of behaviour. Using objectively measured behaviour and area-level deprivation, meta-analyses suggested that the gap between self-efficacy and behaviour was greater amongst the more deprived ( $B = .17$  [95% CI = 0.02, 0.31]).

**Conclusions.** We find no compelling evidence to support the hypothesis that the intention–behaviour gap is greater amongst the more deprived.

## Statement of contribution

### What is already known on this subject?

- Unhealthy behaviour is more common in those who are more deprived.
- This may reflect a larger gap between intentions and behaviour amongst the more deprived.
- The limited evidence to date testing this hypothesis is mixed.

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**What does this study add?**

- In the most robust study to date, combining results from five trials, we found no evidence for this explanation.
- The gap between intentions and behaviour did not vary with deprivation for the following: diet, physical activity, or medication adherence in smoking cessation.
- We did, however, find a larger gap between perceived control over behaviour (self-efficacy) and behaviour in those more deprived.
- These findings add to existing evidence to suggest that higher rates of unhealthier behaviour in more deprived groups may be reduced by the following:
  - Strengthening behavioural control mechanisms (such as executive function and non-conscious processes) or
  - Behaviour change interventions that bypass behavioural control mechanisms.

Morbidity and mortality are socially patterned: Those who are least deprived, on average, live longer and in better health (Marmot *et al.*, 2010). Whilst life expectancy is increasing, this increase has been greatest amongst the least deprived. One of the explanations for the social patterning of health outcomes is the social patterning of health behaviours, in particular smoking, alcohol consumption, poor diet, and physical inactivity (Laaksonen *et al.*, 2008; Lantz *et al.*, 1998; Lynch, Kaplan, & Salonen, 1997; Martikainen, Brunner, & Marmot, 2003; Stringhini *et al.*, 2010; van Oort, van Lenthe, & Mackenbach, 2005). Given the long-standing interest in the social patterning of health outcomes, the lack of data to inform strategies for reducing health inequalities, particularly through changing health-related behaviour, is noteworthy.

In addition, there has been a general lack of progress in reducing health inequalities. This is despite a clear policy focus on reducing health inequalities (Department of Health, 1999; Judge, Platt, Costongs, & Jurczak, 2006; Marmot *et al.*, 2010). Thus, there is a need for more innovative research including a focus on the behavioural contribution to health inequalities and the development of interventions that target these directly.

Targeting behaviour to reduce health inequalities has been largely eschewed in the mainstream health inequalities literature on the grounds that the social patterning of behaviour reflects structural inequalities and social determinants and so should be changed through the latter routes (e.g., Marmot, 2005). Yet, such a complex problem as health inequalities will require multiple solutions, with no one approach necessarily precluding any others.

**Social patterning of the intention–behaviour gap**

Unlike sociological and epidemiological studies, psychological research has for the most part concentrated on health cognitions associated with people's health behaviours, whilst largely leaving structural inequalities out of the equation. Two aspects of health cognitions most studied by psychologists are intention and self-efficacy as exemplified in several seminal theories: Social cognitive theory (Bandura, 1998), protection motivation (Maddux & Rogers, 1983), and the theory of planned behaviour (Ajzen, 1991). Intentions have been defined as conscious decisions and motivations in the enactment of health-related behaviours (cf. Ajzen, 1991), and self-efficacy has been defined as perceived confidence in the ability to perform health-related behaviours (cf. Bandura, 1998). Importantly, many people fail to enact their intentions, thereby producing an intention–behaviour gap (Orbell & Sheeran, 1998; Webb & Sheeran, 2006).

We are unaware of any reviews on the social patterning of the intention–behaviour gap, or the self-efficacy–behaviour gap. Studies assessing the social patterning of intention to consume a healthier diet find that children and adults from higher socio-economic groups have greater intentions to eat more healthily which was associated with consuming a healthier diet (Bere, van Lenthe, Klepp, & Brug, 2008; Leganger & Kraft, 2003; Sandvik, Gjestad, Samdal, Brug, & Klepp, 2009). Similar findings were reported for the social patterning of self-efficacy and diet (Ball *et al.*, 2009). However, a study by Godin, Amireault, *et al.* (2010) did not find any evidence of social patterning of the intention–behaviour gap regarding fruit and vegetable consumption. Studies investigating the social patterning of intention and self-efficacy in relation to physical activity also report that participants from higher socio-economic groups report greater intentions and self-efficacy to engage in physical activity, which were associated with more physical activity compared to their counterparts from lower socio-economic groups (Ball *et al.*, 2007; Cerin & Leslie, 2008; De Cocker *et al.*, 2012; Kamphuis *et al.*, 2008, 2009; Murray, Rodgers, & Fraser, 2012; Pan *et al.*, 2009). However, the findings on physical activity have also been inconsistent. For example, Godin, Sheeran, *et al.* (2010) found that only education moderated the intention–physical activity relationship, with no such effect being found for other socio-economic status (SES) indices including income and social deprivation. A more recent investigation by Schüz *et al.* (2012) found no evidence of SES (expressed as district-level GDP) moderating the relationship between intention and physical activity. To our knowledge, only one study has examined the possible social patterning of self-efficacy on multiple behaviours: Diet, physical activity, smoking, and alcohol, reporting that self-efficacy explains part of the association between socio-economic status and the four types of behaviours (Grebowski *et al.*, 1993).

Taken together, these studies provide an inconsistent pattern of results with, for example, some finding associations with social patterning only amongst women (Pan *et al.*, 2009), and some only for leisure-time activity (Ball *et al.*, 2007). The self-report nature of the measures used to measure behaviour is another weakness of all these studies, not least because social desirability bias may be socially patterned. Furthermore, only a handful of these papers actually carried out a formal analysis of the moderating effect of SES on the intention–behaviour and self-efficacy–behaviour gap (Godin, Amireault, *et al.*, 2010; Godin, Sheeran, *et al.*, 2010; Pan *et al.*, 2009; Sandvik *et al.*, 2009; Schüz *et al.*, 2012) whilst using widely heterogeneous indices of SES thus precluding any possibility of systematic synthesis of these effects.

A recent analysis of data sets concerning three behaviours – smoking in children, breastfeeding in first-time mothers, and physical activity in a workforce – reported that the intention–behaviour gap was narrower amongst those who were least socially deprived (Conner *et al.*, 2013). That is, those who were least socially deprived were more likely to act in line with their intentions, compared to those who were more deprived. Surprisingly, the studies found no evidence for such interaction between deprivation and self-efficacy. This finding conflicts with the evidence reviewed above showing that self-efficacy, a correlate of self-control and more broadly executive function, is related to a range of health behaviours as well as being socially patterned. It should be noted, however, that all three sets of behaviours were assessed by self-report, and assessment of SES was by area of residence in one of the studies, occupation in another, and receipt of free school lunches in the third study. A more robust test using objective measures of behaviour and consistent measures of SES is needed to elucidate the nature of the association between deprivation and the intention–behaviour gap.

In summary, uncertainty remains about the extent to which the intention–behaviour gap is moderated by socio-economic status. Significant moderation by socio-economic status could inform the design and targeting of interventions to reduce the inequality arising from the intention–behaviour gap, and caution against interventions that increase a socially moderated intention–behaviour gap.

### **The present research**

This study comprises a series of analyses using existing data sets with robust measures to examine the extent to which SES modifies the relationship between intention and self-efficacy for different health behaviours.

Study aims:

1. To estimate the extent to which the intention–behaviour relationship is moderated by SES in each of three sets of behaviour: Physical activity, diet, and medication adherence in smoking cessation.
2. To test the extent to which any associations vary with (i) how the target behaviour is measured (self-report vs. objectively measured) and (ii) the index of socio-economic status that is used (individual vs. area level).
3. To consider possible explanations for any observed attenuation of the intention–behaviour relationship in low-SES groups.

### **Methods**

We analysed five data sets, each of which included the following variables:

1. Socio-economic status, measured using individual- and area-level indices.
2. Intention to perform a behaviour.
3. Self-efficacy to perform a behaviour.
4. Behaviour, measured using objective and/or self-report measures.

The data sets available to us included randomized controlled trials of individual-level interventions aimed at changing one or more of three sets of behaviour (physical activity, diet, and medication adherence in smoking cessation). All studies were conducted in England between 2001 and 2012 and included data on 2,511 participants. The main results or protocol papers of these five data sets are published (Godino *et al.*, 2012; Griffin *et al.*, 2011; Kinmonth *et al.*, 2008; Marteau, Aveyard, *et al.*, 2012; Watkinson, van Sluijs, Sutton, Marteau, & Griffin, 2010). The analyses reported in this paper are novel and have not been reported elsewhere.

### **Overview of included data sets and measures**

*Socio-economic status* was expressed in terms of individual- and area-level measures. Both measures were the same across all five studies. Age of leaving full-time education served as a measure of *individual-level SES* (see Chappell, Ota, Berryman, Elo, & Preston, 1996; Liberatos, Link, & Kelsey, 1988). This ordinal measure was coded into a binary categorical variable: 1 = full-time education finished at or below 18 years of age; 2 = full-time education finished after 18 years of age, following Conner *et al.* (2013).

Postcode information was used to obtain an Index of Multiple Deprivation for each participant, serving as the measure of *area-level SES*. Following Conner *et al.* (2013),

this ordinal variable was dichotomized as follows: 1 = low SES (high deprivation); 2 = high SES (low deprivation). Below follow the summaries of the individual studies and measures used.

### **Medication (nicotine replacement therapy) adherence in smoking cessation – Marteau 2012**

Participants comprised 633 smokers wanting to quit (54% women;  $M_{\text{age}} = 47.2$  years) (see Marteau, Aveyard, *et al.*, 2012). They were recruited from general practices and were randomized to receive information that their nicotine replacement therapy (NRT) dose was determined according to their genotype or alternatively their phenotype.

#### *Measures*

*Intention to adhere to NRT use* was measured by two items with good internal reliability ( $r = .69$ ;  $\alpha = .81$ ) that were averaged into a single index: ‘Do you intend to use all your NRT every day in the first 4 weeks of your quit attempt?’ (1 = *definitely do not*, 7 = *definitely do*); ‘How likely is it that you will use all your NRT every day in the first 4 weeks of your quit attempt?’ (1 = *not at all likely*, 7 = *extremely likely*).

*Self-efficacy to use prescribed NRT* was measured by two items that were averaged together ( $r = .57$ ;  $\alpha = .72$ ): ‘I am confident I can use all my NRT every day in the first 4 weeks of my quit attempt’ (1 = *strongly disagree*, 7 = *strongly agree*); ‘How much control do you have over using all NRT every day in the first 4 weeks of quit attempt?’ (1 = *no control*, 7 = *complete control*).

*Objective measure of NRT adherence* was obtained by a research nurse counting the pills consumed by each participants over 28 days following the smoking quit date (expressed as a continuous variable ranging from 0% = *no NRT consumed*, 100% = *all NRT consumed*).

### **Physical activity: Data set 1 and diet – Griffin 2011**

Participants in this trial comprised 478 patients (38% women;  $M_{\text{age}} = 59.7$  years) recently diagnosed with type 2 diabetes. They were randomized to receive either intensive medical treatment alone or intensive treatment coupled with facilitator-led, theory-based individual behaviour change intervention aimed at teaching patients key skills to facilitate change and maintenance of key behaviours (see Griffin *et al.*, 2011).

#### *Measures*

*Physical activity. Intention to be more physically active* was measured by two items that were averaged together into a single index ( $r = .80$ ;  $\alpha = .89$ ): ‘I intend to be more physically active in the next 12 months’; ‘It is likely that I will be more physically active in the next 12 months’ (both anchored on a 5-point scale ranging from 1 = *strongly disagree*, 5 = *strongly agree*).

An index of *self-efficacy to engage in physical activity* was made by averaging two items together ( $r = .65$ ;  $\alpha = .78$ ): ‘I am confident that I could be more physically active in the next 12 months, if I wanted to’; ‘It would be difficult for me to be more physically active in the next 12 months even if I wanted to’ (reverse scored) (both anchored on a 5-point scale ranging from 1 = *strongly disagree*, 5 = *strongly agree*).

*Objective measure of physical activity* was obtained by an ActiHeart device (CamNtech, Cambridge, UK; see Brage, Brage, Franks, Ekelund, & Wareham, 2005) recording participants' activity via individually calibrated heart rate and movement sensing. Physical activity energy expenditure was captured at 12 months post-baseline and expressed as a continuous variable summarized in kJ/kg/day. *Self-report measure of physical activity* consisted of a validated questionnaire EPAQ2 (Wareham & Rennie, 1998) measured at 12 months post-baseline (expressed as a continuous variable denoting weekly total activity energy expenditure discounting resting).

*Diet. Intention to consume a lower fat diet* was measured by two items that were combined in a composite measure ( $r = .8$ ;  $\alpha = .89$ ): 'I intend to eat a lower fat diet in the next 12 months'; 'It is likely that I will eat a lower fat diet in the next 12 months' (both anchored on a 5-point scale ranging from 1 = *strongly disagree*, 5 = *strongly agree*). *Self-efficacy to consume a lower fat diet* was measured by two items averaged together ( $r = .67$ ;  $\alpha = .8$ ): 'I am confident that I could eat a lower fat diet in the next 12 months, if I wanted to'; 'It would be difficult for me to eat a lower fat diet in the next 12 months even if I wanted to' (reverse scored) (anchored from 1 = *strongly disagree* to 5 = *strongly agree*).

*Self-report measure of consumption of fat as a percentage of energy* consisted of a validated food frequency questionnaire (FFQ; McKeown *et al.*, 2001) calculated as a delta change score between participants' measures obtained at baseline and after 12 months. This study did not use an objective measure of dietary fat.

### **Physical activity data set 2 – Kinmonth 2008**

Three hundred and sixty-five sedentary adults (62% women;  $M_{\text{age}} = 40.4$  years) with parental history of type 2 diabetes participated in the ProActive trial. Participants were randomized to receive a brief advice leaflet (control group), theory-based facilitator-led behaviour change programme delivered in participants' homes, or delivered via the telephone (Kinmonth *et al.*, 2008).

#### **Measures**

*Intention to be more physically active* was measured by two items that were averaged together into a single index ( $r = .63$ ;  $\alpha = .77$ ). *Self-efficacy to be more physically active* was measured by two items averaged in a single index ( $r = .39$ ;  $\alpha = .54$ ). These items were identical to the ones used in the trial by Griffin *et al.* (2011) described above.

*Objective measure of physical activity* was captured by the daytime physical activity ratio (dayPAR), which is the ratio of daytime energy expenditure to resting energy expenditure measured using heart rate monitoring with individual calibration for the heart rate–energy expenditure relationship (Polar monitor, Kempele, Finland). Our measure was obtained by calculating a delta change score between the measures gathered at baseline and after 1 year on participants' energy expenditure levels. *Self-report measure of physical activity* consisted of a validated questionnaire EPAQ2 (Wareham & Rennie, 1998) calculated as a delta change score between participants' measures obtained at baseline and after 1 year (expressed as a continuous variable denoting weekly total activity energy expenditure discounting resting).



### **Physical activity data set 3 – Watkinson 2010**

Four hundred and sixty-six healthy participants (57% women;  $M_{\text{age}} = 47.2$  years) recruited from a population-based observational study were randomized to either a control group (no feedback) or to one of three types of personalized physical activity feedback groups ('simple', 'visualized', or 'contextualized') (see Watkinson *et al.*, 2010).

#### *Measures*

*Intention to be more physically active* was measured by a single item: 'I intend to be more physically active in the next 2 months' (1 = *strongly disagree*, 5 = *strongly agree*). *Self-efficacy to engage in more physical activity* was measured by two items identical to the ones used in Griffin *et al.* (2011) and Kinmonth *et al.* (2008) ( $r = .52$ ;  $\alpha = .67$ ).

*Objective measure of physical activity* was obtained by an ActiHeart device (CamNtech; see Brage *et al.*, 2005) recording participants' activity via individually calibrated heart rate and movement sensing (expressed as a continuous variable in kJ/kg/day, in this case calculated as a delta change score between baseline and 2-month follow-up). *Self-report measure of physical activity* was obtained via a validated Recent Physical Activity Questionnaire (RPAQ; Besson, Brage, Jakes, Ekelund, & Wareham, 2010) that probes participants for their physical activity levels at work, travel, recreation, and domestic life (expressed as a continuous delta change score between baseline and 2-month follow-up).

### **Physical activity data set 4 and diet – Godino 2012**

Five hundred and sixty-nine participants (53% women;  $M_{\text{age}} = 47.1$  years) recruited from a population-based observational study were randomized to standard lifestyle advice alone (control group), or in combination with a genetic or a phenotypic estimate of their lifetime risk of developing type 2 diabetes (see Godino *et al.*, 2012).

#### *Measures*

*Physical activity.* *Intention to be more physically active* was measured by a single item: 'I intend to be more physically active in the next 8 weeks' (1 = *strongly disagree*, 5 = *strongly agree*). *Self-efficacy to engage in more physical activity* was measured by a single item: 'I am confident I could be more physically active if I wanted to' (1 = *strongly disagree*, 5 = *strongly agree*).

*Objective measure of physical activity* was obtained by an ActiHeart device (CamNtech; see Brage *et al.*, 2005) recording participants' activity via individually calibrated heart rate and movement sensing (expressed as a continuous variable in kJ/kg/day, calculated as a delta change score between baseline and follow-up). There was no self-report measure of physical activity in this study.

*Diet.* *Intention to consume more fruit and vegetables* was measured by a single item: 'I intend to consume five servings of fruit and vegetables each day over the next 8 weeks' (1 = *extremely unlikely*, 5 = *extremely likely*). *Self-efficacy to consume more fruit and vegetables* was measured by a single item: 'I feel confident in my ability to consume five servings of fruit and vegetables each day over the next 8 weeks' (1 = *strongly disagree*, 5 = *strongly agree*).

*Self-report measure of fruit and vegetables consumption* consisted of a validated questionnaire FFQ (McKeown *et al.*, 2001) calculated as a delta change score between participants' measures obtained at baseline and at follow-up. This study did not use an objective measure of consumption of fruit and vegetables.

**Analyses**

*Regression analyses*

First, we examined the distribution and intercorrelation of measures (see Tables 1–5). Second, using the same strategy as Conner *et al.* (2013), we conducted a series of multiple linear regression analyses for each target behaviour in each study in turn. Before analyses, we mean-centred the indices of intention and self-efficacy and standardized the final scores of the behaviours in studies where the use of delta change scores was not possible. At Step 1, we entered the demographic variables: Age, gender, and SES. At Step 2, we added the variables of intention and self-efficacy. In the third and final step, we added the interaction terms between SES and the mean-centred indices of intention or self-efficacy.

*Meta-analyses*

For the second part of this paper, we pooled the results of our models and examined them as part of meta-analyses to provide a more robust test of the hypothesis that SES moderates the intention–behaviour gap, thus providing more precise estimates of effect sizes (see Cumming, 2014, for discussion and recommendation of this procedure). We conducted separate meta-analyses for objective and self-report measures of behaviours and different types of SES index (individual vs. area level).

*Final measurements and delta scores*

In our studies, measures of intention and behaviour were well aligned. In other words, in some of our studies participants indicated their intentions to change a particular behaviour, whereas in some studies participants indicated their intentions to simply

**Table 1.** Means, standard deviations, and intercorrelations (medication adherence in smoking cessation – Marteau 2012)

	1	2	3	4	5	6	7	8
1. Gender		.08*	.07	.04	-.09*	-.01	-.11**	.02
2. Age			-.11**	-.08*	-.08	.09*	.12**	.08*
3. Ethnicity				.05	-.04	-.01	-.04	.06
4. Individual-level SES					-.04	-.04	-.05	.12***
5. Area-level SES						-.07	-.01	.00
6. Self-efficacy							.52***	.01
7. Intention								.03
8. Objective NRT on day 28								
Mean	–	47.23	1.18	0.16	0.16	5.95	6.31	66.04
SD	–	13.31	0.65	0.37	0.36	1.14	1.02	37.74

Note. NRT = nicotine replacement therapy; SES = socio-economic status.  
Significance denoted as \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .



**Table 2.** Means, standard deviations, and intercorrelations (physical activity, diet – Griffin 2011)

	1	2	3	4	5	6	7	8	9	10	11	12
1. Gender		-.04	-.10*	.08	.03	.10	.00	.08	-.03	.25***	.14**	-.04
2. Age			-.07	-.13**	-.01	-.24***	-.1**5	-.18***	-.11*	-.35***	-.18***	-.05
3. Ethnicity				.24***	.04	.07	.09	.08	.07	-.01	-.07	.06
4. Individual-level SES					.11*	.18***	-.01	.08	-.01	.02	-.04	.00
5. Area-level SES						.01	.00	.05	-.01	-.01	.04	.10
6. Self-efficacy (PA)							.42***	.67***	.32***	.18***	.14***	-.05
7. Self-efficacy (diet)								.39***	.70***	.13**	.11*	-.13**
8. Intention (PA)									.49***	.09	.19***	-.09
9. Intention (Diet)										.10*	.16**	-.15**
10. Objective (PA)											.30***	.00
11. Subjective (PA)												-.14**
12. Subjective delta (diet)												
Mean	–	59.67	1.04	0.18	0.80	3.75	3.73	3.75	3.77	34.49	87.58	–0.78
SD	–	7.50	0.28	0.38	0.40	0.86	0.81	0.78	0.94	17.08	53.11	5.90

Note. SES = socio-economic status.

Significance denoted as \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

**Table 3.** Means, standard deviations, and intercorrelations (physical activity – Kinmonth 2008)

	1	2	3	4	5	6	7	8
1. Gender		-.02	.13*	.04	-.11*	-.02	-.02	.06
2. Age			-.06	.00	-.06	-.12*	.06	-.02
3. Individual-level SES				.07	.09	.01	.00	-.10
4. Area-level SES					.08	.00	-.03	-.12*
5. Self-efficacy						.46***	-.03	-.04
6. Intention							.03	.11
7. Objective PA delta								-.03
8. Subjective PA delta								
Mean	–	40.42	0.24	0.92	3.84	3.72	0.11	16.99
SD	–	5.96	0.43	0.27	0.59	0.63	0.60	50.52

Note. SES = socio-economic status.

Significance denoted as \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

**Table 4.** Means, standard deviations, and intercorrelations (physical activity – Watkinson 2010)

	1	2	3	4	5	6	7	8	9
1. Gender		.08	.07	.03	.02	.04	-.06	-.10*	.05
2. Age			-.03	-.01*	-.01	-.09*	-.11*	.04	.00
3. Ethnicity				.01*	.05	.03	.05	.01	-.04
4. Individual-level SES					.15**	-.02	.06	-.10*	.04
5. Area-level SES						-.01	.08	-.10	.01
6. Self-efficacy							.39***	-.15**	.08
7. Intention								-.11*	.07
8. Objective PA delta									-.04
9. Subjective PA delta									
Mean	–	47.19	1.01	0.27	0.60	3.49	3.34	0.39	-24.19
SD	–	6.79	0.12	0.45	0.49	0.77	0.87	12.19	58.01

Note. SES = socio-economic status.

Significance denoted as \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

engage in certain behaviours. Therefore, some of our included studies used changes from baseline and some used final measurements alone. Measures of the actual change were then derived by calculating before-and-after differences in the behaviour of interest. Change scores provide a more powerful test by eliminating undesirable between-participant variability. Furthermore, changes from baseline are addressing exactly the same underlying moderation effects as analyses based on final measurements. Change scores were used when possible to increase precision and those studies were appropriately given higher weights in the meta-analyses. However, as can be seen from the study-level analyses (see Appendix S1), no systematic differences emerged between studies using change scores and final outcome measures.

#### *Random-effects meta-analysis*

Regression models were fitted individually to the data sets for self-report and objective measures of behaviour. The outcomes of interest in our meta-analyses were the

**Table 5.** Means, standard deviations, and intercorrelations (physical activity, diet – Godino 2012)

	1	2	3	4	5	6	7	8	9	10
1. Gender		.02	.10*	.13**	-.06	-.12	-.08	-.11	.01	.00
2. Age			-.12**	.10*	-.04	-.04	.13	.16	.03	.08
3. Individual-level SES				.19***	.05	-.01	.02	.03	-.01	-.06
4. Area-level SES					.01	-.02	-.02	.06	-.04	.01
5. Self-efficacy (PA)						.32	.28	.20	.05	.01
6. Intention (PA)							.12	.10	.07	-.02
7. Self-efficacy (diet)								.76	.05	.00
8. Intention (diet)									.04	.03
9. Objective delta (PA)										.03
10. Subjective delta (diet)										
Mean	–	47.09	0.44	0.59	3.87	3.40	3.89	3.84	1.40	–6.29
SD	–	7.34	0.50	0.49	0.77	0.86	0.96	0.97	15.23	285.47

Note. SES = socio-economic status.

Significance denoted as \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

unstandardized regression coefficients estimating the interactions between individual- or area-level SES, and intention or self-efficacy: Individual-level SES  $\times$  intention, individual-level SES  $\times$  self-efficacy, area-level SES  $\times$  intention, area-level SES  $\times$  self-efficacy. Random-effects meta-analyses were conducted across studies for each of these four interaction terms separately for self-report and objective measures of behaviour, generating eight meta-analyses in total.

### Heterogeneity

The chi-squared test for heterogeneity showed no significant results. As the chi-squared test of heterogeneity has low power in a meta-analysis when studies are few in number as in our case, a  $p$ -value of .10, rather than the conventional level of .05, was used, thus providing a more conservative test.

## Results

### Individual analyses of studies

In the regression analyses, we found no support for the hypothesized moderation of the intention–behaviour gap by socio-economic status. In particular, none of the interactions involving SES was statistically significant.<sup>1</sup> A detailed breakdown of these analyses can be seen in the Appendix S1 accompanying this paper.

### Meta-analyses

Meta-analyses for both objective and self-report measures of behaviour in each of the five studies, using both individual- and area-level measures of SES, did not show significant moderation between SES and intention on behaviour. At a meta-level, using objectively measured behaviour only and SES as an area-level variable, meta-analyses revealed a

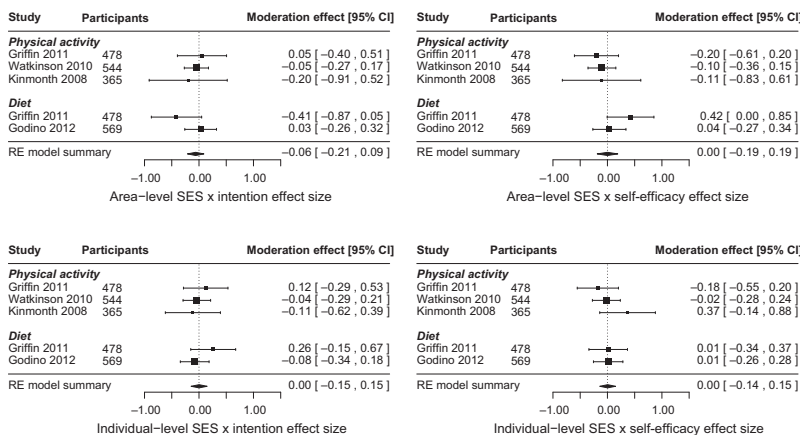
<sup>1</sup> All five studies included in our analyses were randomized controlled trials. Therefore, we also carried out our analyses by controlling for randomization condition which did not change our findings.

significant interaction between self-efficacy and SES ( $B = .17$  [95% CI = 0.02, 0.31]). This was the only statistically significant effect. Breaking down the significant interaction into simple main effects showed that the health behaviours of individuals living in more deprived areas did not change with their level of self-efficacy, whereas individuals living in less deprived areas engaged in more healthy behaviours when they had higher self-efficacy (Figures 1 and 2). Interestingly, albeit not significant, the interaction between area-level SES and intention using objectively measured behaviour reveals a pattern of results that is different from the findings reported by Conner *et al.* (2013). The meta-analyses did not provide an indication of any other trends in the data.

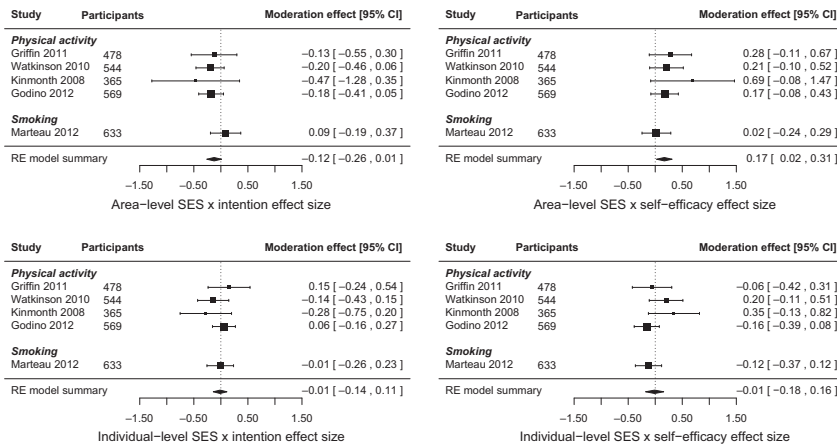
## Discussion

This paper examined the hypothesized moderation by SES of the relationship between intention and behaviour, and self-efficacy and behaviour. Across five studies, using both multiple linear regression analyses and meta-analyses on both objective and self-report measures of behaviour, and using both individual- and area-level measures of SES, we found no significant interactions between SES and intention on behaviour. Using objectively measured behaviour and area-level deprivation, meta-analyses suggested that the gap between self-efficacy and behaviour was greater amongst the more deprived. No other effect was significant.

The strongest evidence to date for the moderation by SES of the intention–behaviour gap presented analyses from three studies all of which used self-report measures of behaviour (Conner *et al.*, 2013). SES did not moderate the relationship between self-efficacy and behaviour. By contrast, we did not replicate these findings for self-reported health behaviours in any of the five studies in which we followed Conner’s data analytic approach. We did, however, replicate the lack of moderation of SES for the relationship between self-efficacy and behaviour. By pooling our data into meta-analyses for a more robust test of the hypotheses and using objective measures of behaviour, we again failed to replicate the intention–behaviour moderation by SES. We did, however, find that SES moderated the link between self-efficacy and behaviour when SES was measured as an area-level variable.



**Figure 1.** Forest plots of the interactions between individual- (bottom) and area-level (top) socio-economic status (SES) with intention (left) and self-efficacy (right) on self-reported behaviours.



**Figure 2.** Forest plots of the interactions between individual- (bottom) and area-level (top) socio-economic status (SES) with intention (left) and self-efficacy (right) on objectively measured behaviours.

We consider five possible explanations for our non-replication of Conner *et al.*'s (2013) findings, relating to differences in samples, measures, types of behaviours studied, data analysis, and data interpretation. Although there were some differences in populations sampled, measures used, types of behaviour studied, and data analytic approach, there were also sufficient similarities in all these domains to suggest that they are unlikely explanations for the non-replication. In addition, we note that the strength of associations between SES and intention was similarly small and not significant in all three of Conner's data sets and all five data sets included in the current analysis. We therefore turn to discuss differences in data interpretation that may have led to our non-replication.

### Statistical power

Considering the small effect sizes of the interactions between intention and SES on behaviour, it is important to consider the statistical power for detecting these small effect sizes. Our studies (combined  $n = 2,511$ ) had more statistical power for detecting these interactions than did Conner *et al.* (combined  $n = 1,537$ ) and furthermore, we pooled our studies into a meta-analysis, thereby allowing us to provide a more robust test of the moderation hypothesis. This way we were able to address a common limitation of field experiments, where tests for moderations are often underpowered (cf. McClelland & Judd, 1993). That we did not find the interactions reported by Conner in the analyses of the individual studies and meta-analyses points to the need for caution in the interpretation of SES as a potential moderator of the intention-behaviour gap.

### Effect sizes

Our analyses highlight the need to consider effect sizes in research rather than to rely on traditional significance tests (cf. Ioannidis, 2005). An examination of Conner *et al.*'s effects reveals small effects that may contribute to the non-replicability of the SES moderation of the intention-behaviour gap. Our study points to the need to re-evaluate the importance of intention in the social patterning of health behaviours. Considering the

small effects obtained by Conner, other variables beyond intention are needed to elucidate the socio-economic patterning of health behaviours.

Moreover, whilst Conner *et al.* reported medium to large effects between intention and behaviour, and self-efficacy and behaviour, we found weak and inconsistent relationships between intention and behaviour, and self-efficacy and behaviour in our studies. Our findings are compatible with the meta-analysis by Webb and Sheeran (2006), which concluded that the link between intention and behaviour is much weaker than previously assumed (cf. Armitage & Conner, 2001). The authors found that interventions that had a large effect on individuals' intentions only produced a small change in behaviour that can be attributed to the intentional control of behaviour. They went on to suggest that as the interventions may have activated behaviour-consistent goals outside of participants' conscious awareness, future research on behaviour change should explore non-conscious processes.

Executive function is one such set of pertinent non-conscious processes (Marteau & Hall, 2013). Executive function is a theorized control network linked to the prefrontal cortex that regulates behaviour, comprising three core cognitive functions: Response inhibition (including self-control), working memory, and attention (Diamond, 2013). Importantly, it engenders the ability to persist with a goal in unsupportive environments. Several studies to date have investigated aspects of executive functioning as modifiers of the well-established gap between behavioural intentions and actual behaviour. For example, differences in executive functioning were used to explain variations in maintaining a healthy lifestyle amongst undergraduates (including daily fruit and vegetable consumption, engaging in recommended levels of physical activity, sleeping at least 8 hr per night, consuming breakfast, moderating the consumption of alcohol, and avoiding smoking) (Booker & Mullan, 2013; for a review see Vainik, Dagher, Dubé, & Fellows, 2013). Importantly, executive function (particularly response inhibition) was significantly predictive of engagement with healthier behaviours amongst those students living in environments unsupportive of healthier behaviours (Booker & Mullan, 2013). Growing evidence also shows that executive function in childhood and adulthood is associated with socio-economic status at birth (Moffitt *et al.*, 2011; Raver, Blair, & Willoughby, 2013). In our sample, the relationship between health behaviour and self-efficacy (the ability to control behaviour and a correlate of executive function) was moderated by SES. This gap was greatest amongst those living in areas of high deprivation, further highlighting the importance of the environment as a non-conscious behavioural cue, the need to explore the role of executive function in the enactment of health behaviours, and how this may be modified by SES. Future studies investigating this could usefully integrate more direct measures of executive function, such as the Stroop, Stop Signal, and Go/No Go tasks (for a discussion of different executive function measures see Diamond, 2013).

### **Priors**

Another pertinent point for discussion concerns the prior expectation, based on evidence, that SES moderates the relationship between intention and behaviour. Many of the papers reporting social patterning in the execution of different health behaviours did not formally test for the moderating effects of SES on the relationship between intention and self-efficacy with behaviour (Ball *et al.*, 2007, 2009; Bere *et al.*, 2008; Cerin & Leslie, 2008; De Cocker *et al.*, 2012; Kamphuis *et al.*, 2008, 2009; Leganger & Kraft, 2003; Murray *et al.*, 2012). Furthermore, the few papers that did test for such moderating effects have been inconsistent, reporting no significant effects of moderation by SES on intention



to be more physically active (Schüz *et al.*, 2012), or to eat more fruits and vegetables (Godin, Amireault, *et al.*, 2010), with Godin, Sheeran, *et al.* (2010) finding that only education moderated the intention–physical activity relationship, with no such effect being found for other SES indices including income and social deprivation. Therefore, the priors taken together in conjunction with ours and Conner *et al.*'s findings suggest that the relationship between SES and the intention–behaviour gap is more complex than previously thought and requires further empirical investigation. In a similar vein, Godin's (2013) invited commentary on the Conner *et al.* (2013) paper argued that the moderation of the intention–behaviour gap by SES requires further examination. Godin surmised that the inconsistent effects may arise from differences in the cultural context in which a study was conducted, the characteristics of the sample under study, the nature of the behaviour studied as well as the type of SES index used (individual or area level). Our analyses hint that the type of SES index used may affect the results of such analyses. Future studies should use different operationalizations of SES, utilizing both area- and individual-level indices of SES, to capture different facets of relative deprivation. Moreover, our findings highlight the need to replicate these analyses with more varied health behaviours (including more episodic behaviours).

The paucity of studies formally testing the moderating role of SES of the intention–behaviour gap, combined with the heterogeneity in the measurement of SES, precludes us from conducting a systematic review on the topic. However, prior evidence and our robust combined analyses of data sets that had homogeneous indices of SES (both individual and area level) suggest that thus far there is no evidence of a larger intention–behaviour gap amongst the more deprived.

### **Strengths and limitations of the present research and recommendations for further empirical investigations**

A notable strength of our study is that it is the first to use objectively measured health behaviours to examine the social patterning of the gap between intention and behaviour, as well as between self-efficacy and behaviour. Furthermore, the studies included in the current analyses used both individual- and area-level measures of SES, uniformly measured across all five studies, allowing us to examine the varying effects of SES as a function of how it is measured. Our finding of a significant moderation of the relationship between self-efficacy and behaviour only when SES was captured as an area-level variable suggests that SES may have different effects on health behaviours depending on how it is defined. Prior studies have demonstrated a relationship between area-level deprivation with physical activity and diet, via decreased access to neighbourhood opportunities to be more physically active (Panter, Jones, & Hillsdon, 2008) and via increased access to unhealthy food outlets (Burgoine, Forouhi, Griffin, Wareham, & Monsivais, 2014). Thus, it is plausible that area-level deprivation interacts with the particular types of behaviour we examined that depend on environmental influences. Measures of individual-level SES may perhaps interact with behaviours whose execution does not depend on the wider environment, such as daily brushing of teeth and condom wearing. The differential effects of area versus individual level of SES warrant further empirical investigation.

Adding further strength to our studies are the well-developed and matched measures of intention and self-efficacy. Our studies for the most part used multiple indices to measure intention and self-efficacy which had good interitem reliabilities. This contrasts with Conner *et al.*'s (2013) studies that used single-item measures of intentions in two of the three included studies. Furthermore, all our studies used intention and self-efficacy

indices that were carefully time-matched with the behaviour measures (for more details see Methods section).

One of the limitations of our studies is that we only looked at three health behaviours. As we used strict criteria in selecting studies that measured behaviours objectively and/or subjectively, captured SES at both individual and area level, and had well-matched and reliable indices of intention and self-efficacy, we limited our analyses to the five studies which measured physical activity, diet, and medication adherence in smoking cessation. All three health behaviours we examined are habitual; therefore, a question remains whether the same pattern of results would emerge for episodic health behaviours, such as screening and vaccination. Previous research has suggested that the impact of intentions may be diminished in habitual health behaviours (Ouellette & Wood, 1998; Webb & Sheeran, 2006). Therefore, future work should aim to further investigate the relationship between SES, intention, self-efficacy, and health behaviours, using different examples of health behaviours, including episodic health behaviours.

Finally, we carried out multiple statistical analyses on our dependent variables of interest, thus potentially inflating the familywise type I error rate. Therefore, our only significant effect observed may be due to chance and type I error. The robustness of our conclusions therefore depends on future replications.

### **Implications for future research and policy**

There are two major implications for future research and policy arising from our analyses: Interventions targeting the intention–behaviour gap may not be effective to counter SES related health disparities. The effect sizes observed in previous studies were small and the effects did not replicate in the present research using both subjective and objective measures. This underlines the importance of replication studies and considering effect sizes as a criterion to evaluate research outcomes, in addition to statistical significance (Cohen, 1994).

At present, there is no compelling evidence for a socio-economic patterning of the intention–behaviour gap. This finding, combined with evidence that intentions are weak predictors of behaviour regardless of SES, adds further weight to the scientific case for targeting non-conscious processes to change behaviour across all social groups (Marteau, Hollands, & Fletcher, 2012; Webb & Sheeran, 2006).

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### Supporting Information

The following supporting information may be found in the online edition of the article:

**Appendix S1.** Individual regression analyses for the five data sets.